Examining Validity of Behavioral Indicators

An Application of Smallest Space Analysis

Ben Jann
Dept. of Sociology, Berne University

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Contents:

Latent variable: abstract, not directly observable construct (e.g., attitudes towards an object, values, intentions)

The measurement of latent variables:

- observation of a set of manifest (i.e., empirically observable) variables that are linked to the construct (indicators, items)
- generation of scales/indices by adding up the values of the single items
- assumption: homogeneity of the indicators
  (the single indicators are independent, more or less erroneous measures of the same construct such that various indicator sub-groups yield a similar value)
- criterion for determination of items: item-total correlations ("the sum is less mistaken")

Testing multi-item measurements:

- item-consistency analysis: split-half method, Cronbach's α (reliability analysis) (testing the homogeneity of a scale by analyzing the inter-item correlations)

- factor analysis (determination of the effects of other constructs; gives evidence upon the validity of the measurement)

Item-consistency analysis and factor analysis give rise to a number of problems:

- metric scale level is required
- the relations between different components of the measurement stay unclear
- in a lot of cases the assumptions of classical test theory do not suffice

Contribution of smallest space analysis (SSA) in exploring multi-item measurements

- examination of the heterogeneity of the items (no supposition of homogeneity)
- examination of the relations between different components
- great scope for interpretation since only little ad-hoc assumptions are made
- weak demands on the scale characteristics

Example: the measurement of environmental behavior. Two methods:

1. Environmental behavior (EB): simple additive index of 16 single pro- or contra-ecological actions from the domains “shopping”, “recycling”, “energy-saving” and “traffic”. The index might be criticized to be a measure of “symbolic behavior” only.

2. Environmentally relevant behavioral consequences (ERC): estimation of the energy and material consumption for the domains “housing” (10), “mobility” (8), “nutrition” (10), “clothing” (3), and “recycling” (3). Each domain is weighted in accordance with its fraction of flows of material and energy (numbers in brackets). Even though, in part, using similar indicators the ERC-index is based on more “objective” data than the EB-index.

The examination of the two scales with conventional methods is problematic:

- Cronbach's α is more or less meaningless, since one might not assume, that people will act consistently over the embraced behavioral domains (especially for the ERC-index)
- factor analysis is of limited value
  - EB-index: three of the four domains define a clear cut component
  - ERC-index: the extracted components just partly correspond to the behavioral domains
  - interpretation of some components is unclear, as well as the relations between the components

The SSA gives more insight (monotonic estimation, ϕ-coefficients and Bravais-Pearson-coefficients, respectively):

- Figure 1 and 2: cyclical ordering, sectors may be assigned to behavioral domains, clear separation of the right and the left half of the figure (high behavioral costs vs. norm-guided actions)

- the two figures closely fit: the indices capture a very similar set of behaviors but emphasize different aspects

- Figure 3: combination and extension of the indicators
  Interpretation: at least four behavioral areas should be separated when environmental behavior is measured

  1. classical environmental actions: separation of garbage, environmentally conscious shopping and nutrition, saving water and electric power
  2. traffic mobility: high ecological relevance and high political relevance
  3. housing: high ecological relevance but less political relevance
  4. clothing: very little association with environmental issues

People with different lifestyles and attitudes will differ in their behavior within those domains and they may be classified along the suggested dimensions.

Conclusion: The construct “environmental behavior” has many facets which have to be measured with different indicators.

Smallest space analysis can be very useful to examine the relations between those indicators and give evidence upon the validity and possible improvements of the measurement.

Applied in addition to conventional methods, SSA allows to recognize the features of a specific multi-item scale. This may prevent a false application of the scale or a problematic interpretation of results.

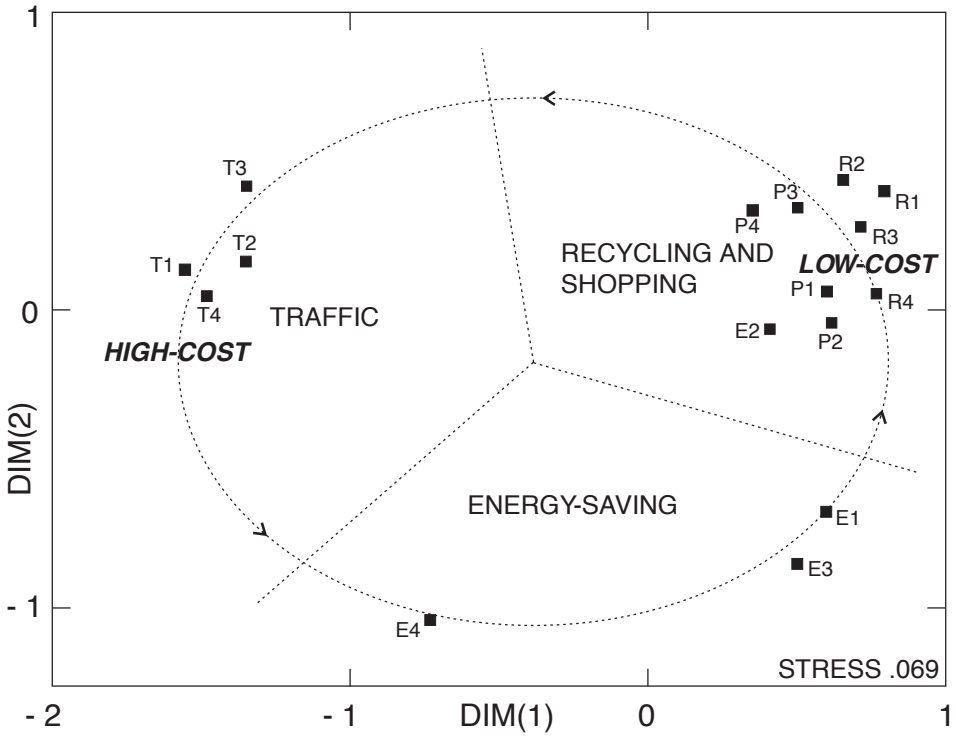

Figure 1. SSA-plot of the indicators of environmental behavior (EB)

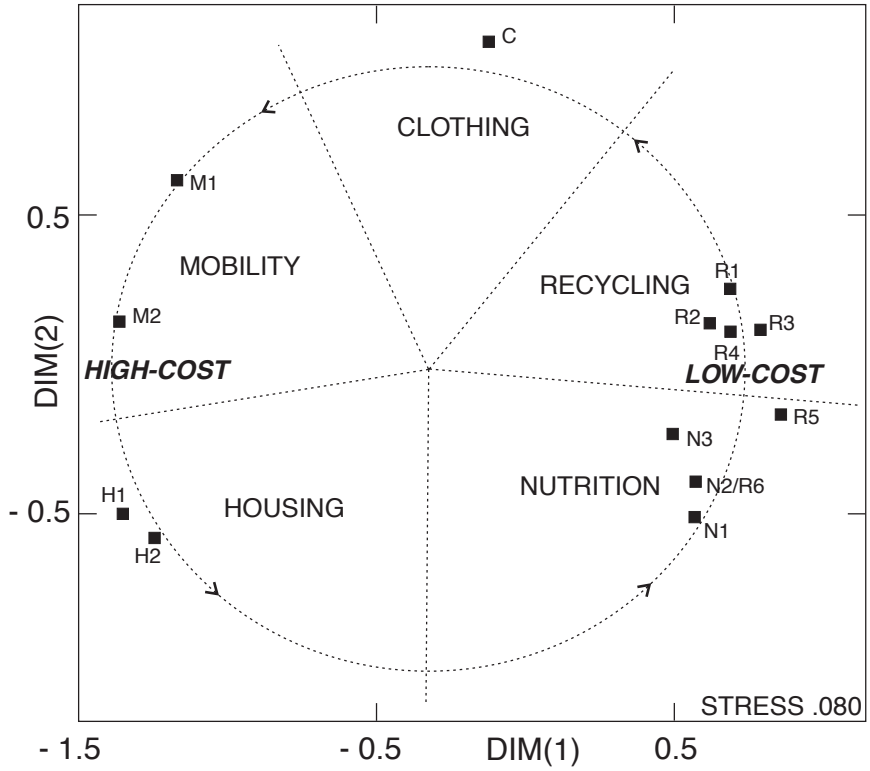

Figure 2. SSA-plot of the indicators of environmentally relevant behavioral consequences (ERC)

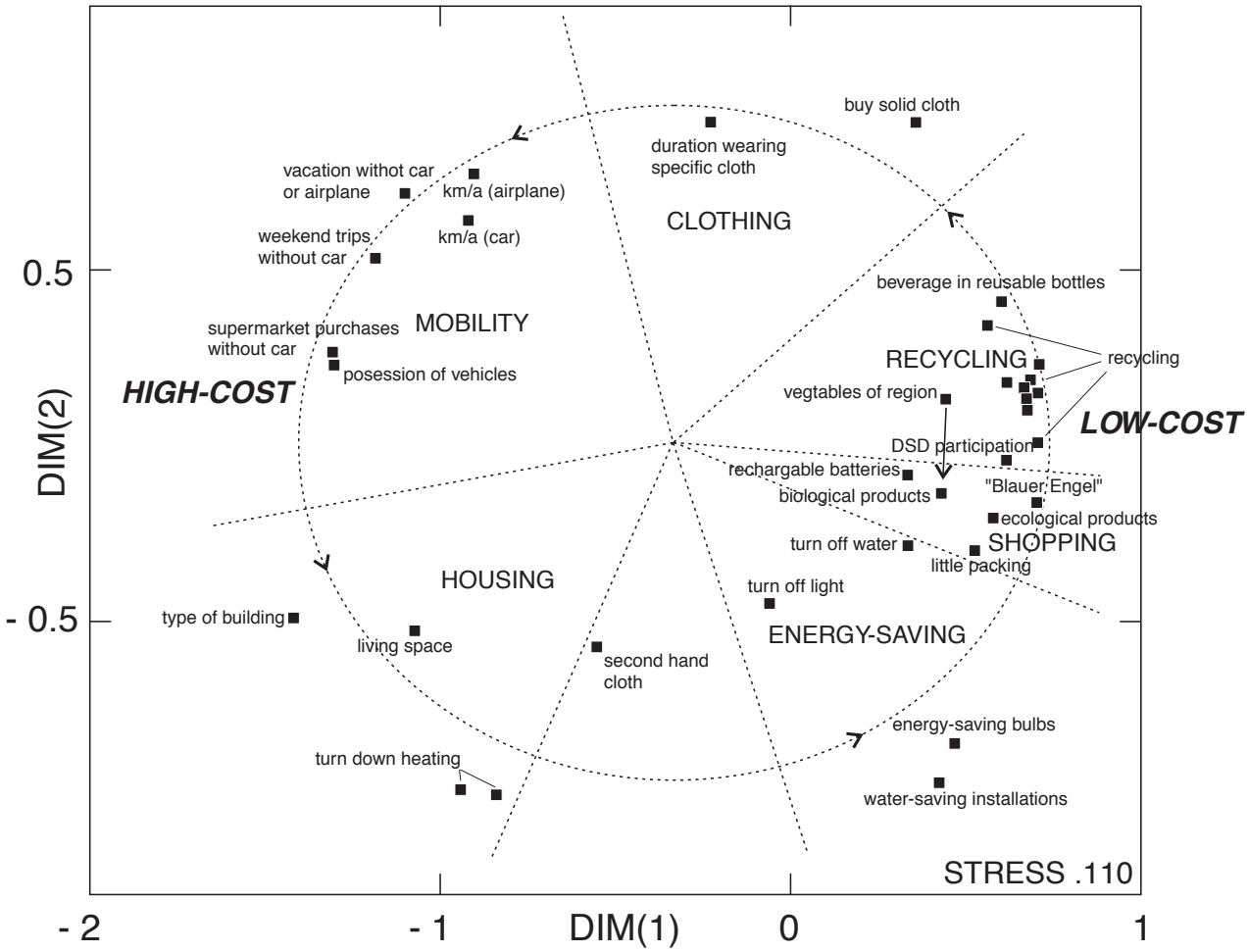

Figure 3. SSA-plot of a variety of indicators for environmental behavior